

## CLAIMS

What is claimed is:

1. A thermal protective coating, comprising:  
in dry admixture,
  - a. from about 5% to about 35% of colloidal silica, colloidal alumina, or combinations thereof;
  - b. from about 23% to about 79% of a filler taken from the group consisting of silicon dioxide, aluminum oxide, titanium dioxide, magnesium oxide, calcium oxide, and boron oxide;
  - c. from about 2% to about 20% of one or more emissivity agents taken from the group consisting of silicon hexaboride, boron carbide, silicon tetraboride, silicon carbide, molybdenum disilicide, tungsten disilicide, zirconium diboride, cupric chromite, and metallic oxides; and
  - d. from about 1.5% to about 5.0% of a stabilizer taken from the group consisting of bentonite, kaolin, magnesium alumina silica clay, tabular alumina, and stabilized zirconium oxide.
2. The coating of claim 1, wherein:
  - a. the emissivity agents are one or more metallic oxides taken from the group consisting of iron oxide, magnesium oxide, manganese oxide, copper chromium oxide, chromium oxide, cerium oxide, terbium oxide, and derivatives thereof.
3. The coating of claim 1, further comprising:
  - a. water forming a wet admixture having a total solids content ranges from about 40% to about 70%.

4. The coating of claim 1, wherein:  
the dry admixture comprises
  - a. from about 10% to about 30% colloidal silica,
  - b. from about 50% to about 79% silicon dioxide powder, and
  - c. from about 2% to about 15% of one or more emissivity agents taken from the group consisting of iron oxide, boron silicide, boron carbide, silicon tetraboride, silicon carbide molybdenum disilicide, tungsten disilicide, and zirconium diboride; and
  - d. from about 1.5% to about 5.0% of a stabilizer taken from the group consisting of bentonite, kaolin, magnesium alumina silica clay, tabular alumina, and stabilized zirconium oxide.
5. The coating of claim 4, wherein:
  - a. the stabilizer is bentonite powder.
6. The coating of claim 5, further comprising:  
water forming a wet admixture having a total solids content ranges from about 40% to about 70%.
7. The coating of claim 1, further comprising:
  - a. a colorant.
8. The coating of claim 1, further comprising:
  - a. a colorant.

9. A thermal protective coating, comprising:  
in dry admixture,
  - a. from about 5% to about 35% of colloidal silica,
  - b. from about 50% to about 79% of a filler, and
  - c. from about 2% to about 20% of one or more emissivity agents taken from the group consisting of silicon hexaboride, boron carbide, silicon tetraboride, silicon carbide, molybdenum disilicide, tungsten disilicide, zirconium diboride, cupric chromite, and metallic oxides; and
  - d. from about 1.5% to about 5.0% of a stabilizer taken from the group consisting of bentonite, kaolin, magnesium alumina silica clay, tabular alumina, and stabilized zirconium oxide..
10. The coating of claim 9, wherein:
  - a. the emissivity agent is a metallic oxide taken from the group consisting of iron oxide, magnesium oxide, manganese oxide, chromium oxide, copper chromium oxide, cerium oxide, terbium oxide, and derivatives thereof.
11. The coating of claim 9, further comprising:
  - a. water forming a wet admixture having a total solids content ranges from about 50% to about 65%.
12. The coating of claim 9, wherein:  
from about 2% to about 15% of an emissivity agent.
13. The coating of claim 12, wherein:  
the emittance agent is taken from the group consisting of boron silicide, boron carbide, silicon carbide, and zirconium boride.

14. The coating of claim 9, wherein:
  - a. the filler is a metal oxide taken from the group consisting of silicon dioxide, aluminum oxide, titanium dioxide, magnesium oxide, calcium oxide, and boron oxide.
15. The coating of claim 9, further comprising:
  - a. a colorant.
16. The coating of claim 9, wherein:
  - a. the stabilizer is bentonite powder.
17. A method of preparing a protective thermal coating for a substrate, comprising the steps of:
  - a. adding a dry admixture to a mixing container wherein the dry admixture contains
    - i. from about 5% to about 35% of colloidal silica, colloidal alumina, or combinations thereof,
    - ii. from about 23% to about 79% of a filler, and
    - iii. from about 2% to about 20% of one or more emissivity agents taken from the group consisting of silicon hexaboride, boron carbide, silicon tetraboride, silicon carbide, molybdenum disilicide, tungsten disilicide, zirconium diboride, cupric chromite, and metallic oxides; and
    - iv. from about 1% to about 5% of a stabilizer taken from the group consisting of bentonite, kaolin, magnesium alumina silica clay, tabular alumina, and stabilized zirconium oxide;
  - b. adding water to the mixing container so that total solids content of wet admixture ranges from about 40% to about 60%; and
  - c. mixing the contents of the mixing container thereby forming a protective thermal coating solution.

18. The method of claim 17, wherein
  - a. the filler is taken from the group consisting of silicon dioxide, aluminum oxide, titanium dioxide, magnesium oxide, calcium oxide, and boron oxide.
19. The method of claim 17, wherein:
  - a. the emissivity agent is a metallic oxide taken from the group consisting of iron oxide, magnesium oxide, manganese oxide, chromium oxide, copper chromium oxide, cerium oxide, terbium oxide, and derivatives thereof.
20. The method of claim 17, further comprising the steps of:
  - a. placing liquid ingredients in the mixing container prior to mixing in dry ingredients.
21. The method of claim 17, further comprising the steps of:
  - a. mixing at high shear until the contents are well dispersed.
22. The method of claim 17, further comprising the steps of:
  - a. providing a storage container, and
  - b. placing the thermal protective coating solution in the storage container for future use.
23. The method of claim 22, further comprising the steps of:
  - a. remixing the thermal protective coating solution in the storage container after storage for current use.
24. The method of claim 17, further comprising the steps of:
  - a. coating a substrate with the thermal protective coating solution.

25. The method of claim 23, further comprising the steps of:
  - a. coating a substrate with the thermal protective coating solution.
26. The method of claim 17, further comprising the steps of:
  - a. curing the coating on the substrate.
27. The method of claim 17, wherein:
  - a. the dry admixture further comprises a colorant.
28. The method of claim 26, wherein:
  - a. curing the coating on the substrate, comprises the steps of:
    - i. air drying the coating on the substrate for about two hours;
    - ii. increasing the temperature of the coated substrate at a rate of about 200°F per hour until a peak temperature of about 1500°F is reached;
    - iii. maintaining the peak temperature for about two hours; and
    - iv. reducing the temperature of the coated substrate to room temperature at a rate of up to about 200°F per hour.

29. A substrate coated with a thermal protective coating, comprising:
  - a. a substrate having a thermal protective coating thereon; and
  - b. the thermal protective coating containing
    - i. from about 5% to about 35% of an colloidal silica, colloidal alumina, or combinations thereof,
    - ii. from about 23% to about 79% of a filler, and
  - c. from about 2% to about 20% of one or more emissivity agents taken from the group consisting of silicon hexaboride, boron carbide, silicon tetraboride, silicon carbide, molybdenum disilicide, tungsten disilicide, zirconium diboride, cupric chromite, and metallic oxides; and
  - d. from about 1.5% to about 5.0% of a stabilizer taken from the group consisting of bentonite, kaolin, magnesium alumina silica clay, tabular alumina, and stabilized zirconium oxide.
30. The coated substrate of claim 29, wherein
  - a. the filler is taken from the group consisting of silicon dioxide, aluminum oxide, titanium dioxide, magnesium oxide, calcium oxide, and boron oxide.
31. The coated substrate of claim 29 wherein:
  - a. the emissivity agent is a metallic oxide taken from the group consisting of iron oxide, magnesium oxide, manganese oxide, chromium oxide, copper chromium oxide, cerium oxide, terbium oxide, and derivatives thereof.
32. The coated substrate of claim 29, further comprising:
  - a. a colorant.